THE JONES CREEK WATERSHED

MONONA & HARRISON COUNTIES, IOWA

A REVIEW · · 1940·1950

JONES CREEK DAM

REGION · 3
SOIL CONSERVATION SERVICE
MILWAUKEE WIS.

JULY·1950

The Jones Creek Watershed
Monona County, Iowa

A Review - 1940 to 1950

Soil Conservation Service
Milwaukee, Wisconsin
June, 1950

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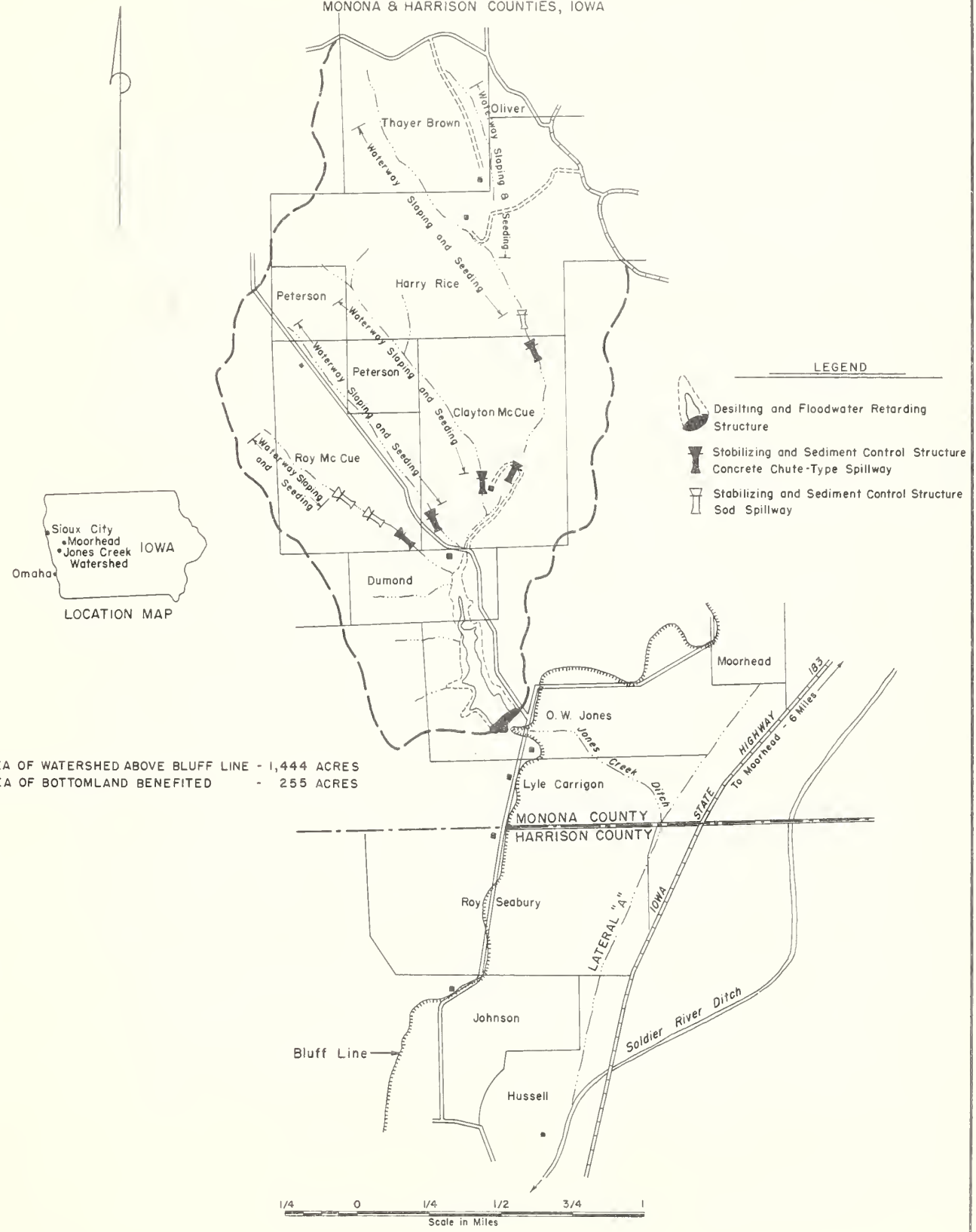
FIGURE I.

JONES CREEK WATERSHED

MONONA & HARRISON COUNTIES, IOWA



AREA OF WATERSHED ABOVE BLUFF LINE - 1,444 ACRES
AREA OF BOTTOMLAND BENEFITED - 255 ACRES

Drafted and Reproduced by the Cartographic Division, Soil Conservation Service, Region III, Milwaukee, Wisconsin. June 13, 1950.

Agr. Soil Conservation Service, Milwaukee, 1950

Drawing Number 3-L-23778

A Review of the Effectiveness
of the Watershed Treatment Program

Jones Creek Watershed, Monona County, Iowa

The Problem

The Jones Creek Watershed, which lies six miles southwest of Moorhead, Iowa (figure 1) is a small tributary of the Soldier River. Its drainage area is 2.26 square miles above the Soldier River bottomlands. This watershed is located in the Missouri Basin Loess Hills, which are covered with loess deposits ranging from less than one to more than 200 feet in thickness. The loess is underlain by Kansas till.

The upland soils are Ida silt loam. Sixty-six percent of the watershed is rough land with slopes over 16 percent. Thirty-four percent of the watershed is colluvial valley land, with slopes of ten percent or less. The slopes average 600 feet in length.

There were no settlers in this watershed until about 1880. When the land was first settled, there was very little tillage. Stock farming was practiced for many years. With the advent of World War I, however, and higher prices for farm products, more intensive cultivation of the land began. Severe sheet erosion and gullying began approximately in 1917. By 1940 large gullies which could not be crossed had dissected the lower part of the watershed. The upper reaches of the watershed were still comparatively free of gullies, but it was clear that in another ten to twenty years they too would succumb to the advancing gully heads. Each year additional areas of good valley land were either being destroyed or rendered inaccessible by gullies.

Farmers were having increasing difficulty in maintaining the Jones Creek ditch across the bottoms to Soldier River. As it continually filled with sediment, crop losses on the bottoms resulting from uncontrolled runoff from the Jones Creek Watershed mounted. Soon much good bottomland had to be taken out of cultivation entirely, because of the very high losses, and retired to pasture.

The sediment which was filling the drainage ditch and spreading over bottomlands was at that time still chiefly topsoil material. The content of sterile sand and subsoil material was increasing, however, and threatened in the future to seriously damage or destroy the fertility of the bottomlands upon which it was being deposited.

The Watershed Treatment Program

In order to cure all of these ills, a comprehensive soil and water conservation program was decided upon. All cultivated

land was converted from straight-row farming to contour cultivation, with some strip cropping. Improved rotations were started. Fifty acres of cultivated land were retired to pasture. Thirty acres of gullied, overgrazed pasture were planted to trees. Existing pastures were improved. Approximately one mile of fence was relocated.

Eight stabilizing and sediment control structures were built. Three of these structures have sod spillways and five have concrete chute-type spillways. An additional structure with chute-type spillway was to have been built at the road crossing, but has not been installed. Approximately three miles of sloping and seeding of waterways, chiefly upstream from the stabilizing structures, was done.

Near where Jones Creek empties onto the Soldier River bottoms, a large structure was built for desilting, flood control, gully control, and stock water. This structure has a drainage area of 2.26 square miles. It is an earth-fill dam of 24,000 cubic yards.

The three-by-three foot drop inlet riser is 18 feet high and formed a pool which was originally 8.8 acres in size, with 75.6 acre-feet of capacity for sediment storage and temporary stock water supply. This inlet restricts the flow to 265 c.f.s. The estimated maximum 50-year runoff from the watershed is 3,600 c.f.s.

Twelve feet above the drop inlet is an emergency sod spillway. At this level, 17.8 acres are flooded; 159.2 acre-feet of temporary flood storage are provided, not including spillway storage. The total original storage capacity of the structure was 234.8 acre-feet.

The structure had a C/W (capacity/watershed) ratio of 34 acre-feet capacity per square mile of drainage area for the sediment pool, and 104 for the entire reservoir. The trap efficiency for sediment is estimated to be 85 percent.

Downstream from this structure, the Jones Creek ditch was cleaned out. Approximately 9,400 cubic yards of sediment were removed.

This work was done during the period 1937-1942. For the purpose of this study, however, 1940 is taken as the average year in which the program was installed.

The Federal Government and the landowners, represented by the Monona County Soil Improvement Association, cooperated in installing the works of improvement. The bottomland farmers furnished a large part of the materials and equipment required for the stabilizing and desilting structures. The government's contribution was largely in the form of labor. This came chiefly from the Moorhead CCC Camp. With the advent of World War II, the Moorhead camp was abandoned and the Denison Conscientious Objectors' Camp assisted in completing the job.

No maintenance was provided for, except that included in normal farm operations. As a result, the sod spillways on the stabilizing structures are not in very good condition. There is also a slight danger of under-cutting of one of the chute-type structures, due chiefly to the fact that the road structure just downstream, which would have protected it, never was constructed.

Cost of the Program

In Table 1 are summarized the total costs of installing the program. Since labor from CCC and Conscientious Objectors' Camps was employed on this job, the actual cost is difficult to arrive at. The costs given in Table 1 are estimated, based upon 1940 contract prices. At 1949 prices the total cost of the work, to both the government and the landowners, would be $80,022 rather than $34,555.

Effectiveness of the Program

The large desilting and floodwater retarding structure has reduced downstream floodflows for rains of one to four inches by 90 percent. Floodwater damage below this point has been virtually eliminated. Sediment damage to the Jones Creek ditch is no longer a problem. Bottomland which had been taken out of crop production because of frequent flooding is now producing again. Tall corn now grows on fertile sediment deposits above stabilizing structures where gullies 40 feet deep existed formerly.

Gully erosion has been virtually stopped. All of the active gully heads are now stabilized. The main gully is still deepening slightly because one stabilizing structure was never installed, but no significant damage is resulting.

Sheet erosion has been reduced 75 percent on the cultivated land. Instead of continuing their downward trend due to soil erosion, crop yields have been increased by soil and water conservation measures.

Infertile overwash material no longer spreads over the bottomlands. In addition, the reservoir now provides a favorite fishing spot for this neighborhood.

In January 1949 a sedimentation survey was made on the large desilting and floodwater retarding structure, using 32 ranges, or cross-sections, and 444 sediment measurements. During the 6.9-year period of measurement, it was found that 32.4 acre-feet of sediment had been deposited in the sediment pool. As volume-weight analyses showed the dry weight of this sediment to be 47.8 pounds per cubic foot, this sediment weighs 34,155 tons.

There has been an annual loss of storage capacity in the sediment pool of 6.22 percent. 42.9 percent had been lost to the date of the sedimentation survey. No sediment was found in

Table 1

Estimated Total Cost of the Watershed Treatment Program
Jones Creek Watershed, Monona County, Iowa
(1940 Prices)

Item	Quantity	Unit	Installation Cost
			(dollars)
Forest Planting	30	Acres	430
Pasture Establishment	50	Acres	810
Contouring			
Intertilled Crops	155	Acres	50
Close-Growing Crops	300	Acres	50
Fence Relocation	1	Mile	160
Waterway Improvement			
Sloping and Seeding	3	Miles	1,000
Structures	8	Each	16,555
Upstream Desilting and Floodwater Retarding Structure	1	Each	12,300
Tributary Channel Improvement	8,450	Lineal Feet	2,000
Increased Farm Operating Cost			1,200(1)
TOTAL			34,555

(1) Total for ten-year period, 1940-1950.

the upper, or temporary flood storage, level.

At this rate, the sediment pool will be filled in 16 years, approximately the designed life of this pool. It should be pointed out in passing that the sediment pool, or the entire reservoir, could have been designed with a larger capacity if a longer period of sediment storage had been desired. However, it was felt that after 15 to 20 years, as the conservation practices in the watershed became more effective, the rate of sediment production would be much less, and a desilting basin would no longer be required. It will still be possible, of course, after the present pool has filled with sediment, to raise the drop inlet riser and provide additional silt storage, together with additional stock water and fishing. Whether the dam will also have to be raised at this time is questionable. Up to the present time, water has never risen to more than 2-1/2 feet above the drop inlet. The emergency spillway is twelve feet above the drop inlet.

Using the formula recently developed for estimating rates of sediment production in the Missouri Basin Loess Hills, the annual rate of sediment production from this watershed before the program was installed is computed to have been 21.3 acre-feet per square mile. It has now been reduced to approximately 2.5 acre-feet per square mile, of which 2.11 acre-feet per square mile have been measured as trapped in the desilting structure. In other words, there has been a reduction in the rate of erosion and sediment production from the watershed of 88 percent.

Because the desilting structure has a trap efficiency of 85 percent, only 0.4 acre-foot of sediment per square mile per year now passes this structure and finds its way to the bottomlands below. Hence the combined effect of the watershed treatment program and the desilting structure has been to reduce the rate of sediment production to the bottoms by 98 percent.

After the silt pool is filled, in 15 to 20 years, if the riser is not raised, the sediment will begin to build up a grade upstream from the riser. Increasing amounts of sediment will pass through the structure and onto the bottomlands below. It should be emphasized, however, that even after the trap efficiency of this structure has been reduced to zero, the sediment load reaching the bottoms can never rise above twelve percent of what it was before the program was installed, because the watershed treatment program alone effects an 88 percent reduction in the rate of sediment production.

Benefits of the Program

1. Obvious Benefits

Because some of the benefits derived from this program are very obvious to the farmers themselves, and some are less obvious, although no less real, the benefits have been divided into two classes in this study: Obvious Benefits and Less

Apparent Benefits. The obvious benefits will be dealt with first.

a. Reduction in Agricultural Damage Due to Inundation

Roy Seabury, who farms 185 acres on the Soldier River bottoms, says that formerly he suffered a loss of 50-60 acres of crops annually due to floods from the Jones Creek Watershed. Another farmer, Lyle Carrigan, states that before the program was installed he lost 35 acres of crops annually. W. R. Jones estimates that he lost 20 acres annually due to Jones Creek floods.

It is estimated that 205 acres of bottomland crops were lost annually because of uncontrolled floodflows from the Jones Creek Watershed before the watershed treatment program was installed. These crops were 85 percent corn and 15 percent oats.

Using a net production value of $48 per acre, the computed average for the years 1940 to 1950, and assuming only 75 percent destruction of these crops, the annual direct damage was found to be $7,390. In addition, an indirect damage of $1,140 in the form of disruption of normal activities, and prevention of efficient use of labor, management, and equipment, was added.

Since the program has been installed on the land, flows have been confined to the ditch channel on the bottoms, and this entire damage has been eliminated. The benefit therefore has amounted to $8,530 annually at actual prices during the period 1940-1950.

b. Reduction in Sedimentation of Jones Creek Ditch

The 1.6 miles of the Jones Creek Ditch and Lateral "A" into which it flowed before emptying into Soldier River were constantly filling with sediment from the Jones Creek Watershed before the program was installed. Although the ditch was not cleaned out as often as it should have been to function properly, the landowners on the bottoms did spend considerable sums in trying to maintain it.

Roy Seabury, for example, spent an average of $333 annually on cleanouts. Including the other bottomland farmers, an estimated $559 was spent annually for this purpose.

Since 1940, an average of $88 has been spent to clean out this ditch. This work was necessitated by sediment deposits from small tributaries south of Jones Creek, on the farms of Messrs. Johnson, Seabury, and Hussell.

The difference between the annual cleanout costs before and after 1940, or $471, is the annual benefit. As stated previously, the sediment load reaching the ditch now is two percent of that which reached it before 1940, and this small percentage, being fine material that will not settle out in the still water of the desilting structure, certainly will not settle out in the flowing water of the ditch below.

c. Land Enhancement on Bottomlands

Prior to installation of the watershed treatment program Roy Seabury had retired 50 acres of good bottom cropland to pasture, because he suffered on this land such frequent and recurring floods from the Jones Creek Watershed. On other farms, approximately 25 additional acres of cropland had been retired to pasture.

Using a landlord's share value of $27 per acre for cropland and $2.50 per acre for pasture for the period from 1940 to 1950, this damage was found to be $1,850 annually.

Since flows have been confined to the channel on this bottom since 1940, this damage has been entirely eliminated.

d. Land Reclamation above Gully-Stabilizing Structures

Above each of the gully-stabilizing structures there have been reclaimed areas of land varying from 0.5 to 1.0 acre. These areas were formerly deep gullies or land made inaccessible by deep gullies. Now, the gullies have been filled with sediment behind these structures and this land has been returned to productive use as cropland. A total of 6.0 acres have been reclaimed on the farms of Clayton McCue, Roy McCue, and Harry Rice.

Using a net production value of $22 per acre since 1940 as compared with zero before, the annual benefit for the last ten years has been $132.

These obvious benefits, which are summarized in Table 2, have amounted to $109,830 at actual prices during the period 1940-1950. At 1949 prices, they would have totalled $125,000 to date.

2. Less Apparent Benefits

In addition to the obvious benefits previously described, there have been many less apparent benefits in the watershed. Among these are the prevention of further serious gully and sheet erosion, the halting of a gradual decline in crop yields due to soil erosion and the beginning of an increase, and the recreational value of fishing in the desilting and floodwater retarding structure. Some of these benefits are taking the form of slow changes and are therefore not readily recognized by the farmers. Others are a little difficult to evaluate in monetary terms. They are, however, real benefits, and are therefore summarized in the following paragraphs.

a. Reduction in Sheet Erosion Damage

On the 505 acres of cropland on the uplands, sheet erosion has been reduced to within allowable limits. This damage

Table 2

Estimated Total Benefits
from the Watershed Treatment Program
1940-1950

Jones Creek Watershed, Monona County, Iowa
(Actual Prices)

Type of Benefit	Total Benefit For 10-year Period 1940-1950 (dollars)
Obvious Benefits	
Reduction in Agricultural Damage due to Inundation	85,300
Reduction in Sedimentation of Jones Creek Ditch	4,710
Land Enhancement on Bottomlands	18,500
Land Reclamation above Gully-stabilizing Structures	1,320
Subtotal	109,830
Less Apparent Benefits	
Reduction in Sheet Erosion Damage	12,200
Reduction in Gully Erosion Damage	133,000
Reduction in Infertile Overwash Damage	850
Conservation Benefit	58,500
Fishing Benefit	6,730
Subtotal	211,280
TOTAL	321,110

and the benefit obtained by eliminating it were computed as follows: In corn equivalents, the annual decrease in crop yields was computed to be 0.45 bushels per acre, or 226 bushels total. This represents a decrease of 0.60 percent per year. Using a landlord's share value of $15 per acre based on actual prices from 1940 to 1950, and 20-year period at four percent interest, the annual damage from decreasing crop yields due to sheet erosion was found to be $2.04 per acre or $1,030 total.

From this was subtracted the annual value of sheet erosion on land which would have been destroyed by gullies in the 20-year period, or $73. Indirect damages caused by sheet erosion, in the form of gradual deterioration of buildings, loss of farm wages, loss in weight and condition of livestock, and the spreading of noxious weeds, was added. This was estimated to be $263 annually.

The annual damage caused by sheet erosion then amounted to $1,220. Since soil losses have been brought within allowable limits, this damage has been entirely eliminated.

b. Reduction in Gully Erosion Damage

In determining the benefits which have resulted through the arrest of growth of the large gullies in the watershed, the same method of computation was used as is now standard in flood control survey reports, such as The Sny Watershed report. It will therefore not be necessary to present here all the details of the computations, but merely the high points.

Gully erosion was found by field measurements to have destroyed or made useless 57.5 acres of land up to 1940. The annual increase in land destroyed by gullying at that time was 1.76 acres. Using a landlord's share value of $15 per acre and a net production value of $25 per acre to represent actual prices from 1940 to 1950, the annual direct damage caused by this gullying was found to be $669.

However, a far more important damage, in the form of land depreciation, was being caused by the spread of these gullies. The gully systems were beginning to cause the retirement of cropland to a less intensive use, such as pasture, woods, or even to idle land. It was estimated that if the gully development had been allowed to continue, 70 percent of the cropland would have been retired to less intensive use within 50 years.

The annual cost of this land depreciation was computed to be $13,331. This figure has been reduced by the value of the sheet erosion damage that will not occur because of the conversion of cropland to less intensive use.

The total annual damage which was being caused by gully erosion before 1940 was then $14,000. Since this damage was reduced by at least 95 percent by the works of improvement in

the watershed, the annual benefit since 1940 has been $13,300.

c. Reduction in Infertile Overwash Damage

Damage by infertile overwash, or lowering of the inherent fertility of the bottomland soils by the deposition of less productive sediment upon them, had not yet reached serious proportions in 1940. However, on the farms of W. R. Jones, Lyle Carrigan, and Roy Seabury, light-colored sediments lacking in organic matter and other nutrients had buried the original productive black soils of the Soldier River bottoms downstream from the Jones Creek Watershed.

This overwash was estimated to have caused a damage to the productivity of these soils up to 1940 of five percent on approximately 50 acres. Each year an additional 4.0 acres of bottomland was being damaged in this fashion.

Using a net production value of $48 per acre and a landlord's share value of $27 per acre, and including an indirect damage in the form of depreciation of land values, the annual damage was found to be $85. Since floodflows are now confined to the channel at this point and the sediment load has been greatly reduced, this type of damage has been entirely eliminated by the program.

d. Conservation Benefit

The measures and practices that contribute directly to reductions in runoff and sediment damage also produce conservation benefits in the form of increased crop yields. Contour farming in particular has increased yields in the watershed through the effect of conservation of moisture.

These increased yields have resulted in an annual benefit, at actual prices from 1940 to 1950, estimated at $5,850.

e. Fishing Benefit

Mr. W. R. Jones, on whose farm the large desilting and floodwater retarding structure is located, estimates that during the 34-week fishing season an average of 18 people fish each Sunday at this nine-acre reservoir. With an average catch of ten bullheads per person, and discounting any fish caught on week-days, this amounts to a weekly catch of 180 bullheads, or an annual catch of 6,120.

Mr. Jones estimates the average weight of these fish to be 1/4 pound. Thus the annual harvest is 1,530 pounds. Estimating conservatively that the angling and food value during the years 1940-1950 was $0.44 per pound, the annual benefit during this period has been $673.

These less apparent benefits, which are summarized in Table 2, have amounted to $211,280 at actual prices during the period 1940 to 1950. At 1949 prices, they would have totalled $239,000 to date.

Total benefits to date, at actual prices, have amounted to $321,110. At 1949 prices, the total benefits to date would have amounted to $364,000.

No attempt has been made to evaluate additional benefits in monetary terms. For example, the water levels in some farm wells have risen. Sediment and floodwater damage to public and farm roads has been greatly reduced. In addition, this job provided employment for a large number of young men in CCC and Conscientious Objectors' Camps, who at the same time became acquainted with soil conservation and the methods used to combat uncontrolled runoff and erosion.

Comparison of Benefits and Costs

Table 3 summarizes benefit-cost ratios as computed by various methods. Costs were computed at both 1940 levels (actual time of installation of program) and at 1949 levels. Benefits were computed as they actually occurred during the years 1940 to 1950, and at 1949 prices. They were computed both by using only the more obvious benefits and by using all benefits.

By any method of computation, it is obvious that the program has already paid for itself several times.

Total benefits and costs are also computed for 20 years and 30 years. After 20 years, when the desilting structure will be silted full to the drop inlet, the annual benefits will decrease slightly. Unless the drop inlet is raised at this time, the fishing benefit will cease, and an increasing amount of sediment will pass through the structure to cause a slight increase in sedimentation in the ditch downstream.

Because no maintenance was provided for the structural portion of the program, it cannot be assumed that the benefits will continue indefinitely. However, barring a flood of greater intensity than the 50-year flood for which these structures were designed, they should continue to produce substantial benefits for at least 30 years. The 30-year benefit-cost ratios will therefore probably give the truest picture of the relation between benefits and costs.

In addition to the benefit-cost ratios shown in Table 3, a comparison can be made between the cost of the large desilting and floodwater retarding structure and the benefits directly attributable to it. These benefits include the reduction in agricultural damage due to inundation, reduction in sedimentation of the Jones Creek ditch, land enhancement on the bottomlands, reduction in infertile overwash damage, and the fishing benefit.

Table 3

Comparison of Costs and Benefits
Jones Creek Watershed, Monona County, Iowa
(Benefit-cost Ratio)

Type of Benefit	Period (Years)				
	10 (to date)		20	30	Average Annual
	Actual Prices	1949 Prices	1949 Prices	1949 Prices	1949 Prices
Obvious Benefits	3.18:1	1.56:1	3.03:1	4.41:1	5.39:1
All Benefits	9.28:1	4.56:1	8.82:1	12.7:1	15.7:1

Using 1949 prices, all benefits, and a 30-year period of benefits, it was found that this structure is justified by a ratio of benefits to costs of 13.6 to 1.

The lack of provision for maintenance, except in increased farm operating cost, is the reason that it is difficult to place the benefit-cost ratio on an average annual basis for an indefinite period of time. However, this has been done in Table 3 in order to facilitate a comparison with the benefit-cost ratios of other watersheds.

This watershed is an example of the benefits which can be achieved by a soil and water conservation program in the Missouri Basin Loess Hills, in which the Little Sioux Watershed also lies. It should be emphasized, however, that even greater benefits can still be achieved in the Jones Creek Watershed and the erosion can be even further reduced and stabilized, if the farmers will take definite action on a neighborhood group basis to complete the job which has been begun, installing the entire program which was planned, and making provision for maintenance of the total program. Thus at little additional expense, considerably larger benefits can be attained.